

What is claimed is:

1. A flexible MEMS transducer, comprising
a substrate of a flexible material;
a membrane layer deposited on the substrate, the membrane layer
having a raised part of a predetermined length;
a lower electrode layer formed by depositing an electrically
conductive material on the membrane layer;
an active layer formed by depositing a piezopolymer on the lower
electrode layer;
an upper electrode layer formed by depositing an electrically
conductive material on the active layer;
a first connecting pad electrically connected to the lower electrode
layer; and
a second connecting pad electrically connected to the upper electrode
layer.
2. The flexible MEMS transducer as claimed in claim 1, further
comprising a lower protective layer coated on the substrate.
3. The flexible MEMS transducer as claimed in claim 2, the lower
protective layer is formed of either silicon nitride or silicon oxide.

4. The flexible MEMS transducer as claimed in claim 2, wherein the lower protective layer has a thickness of less than about 10 μm .

5. The flexible MEMS transducer as claimed in claim 1, wherein the substrate is formed of either a high-molecular (polymeric) material or a metallic thin film.

6. The flexible MEMS transducer as claimed in claim 5, wherein the high-molecular (polymeric) material is polyimide.

7. The flexible MEMS transducer as claimed in claim 1, wherein the membrane layer is formed of silicon nitride.

8. The flexible MEMS transducer as claimed in claim 1, wherein the membrane layer has a thickness of less than about 5 μm .

9. The flexible MEMS transducer as claimed in claim 1, wherein the lower electrode layer and the upper electrode layer are formed of a material selected from the group consisting of metals and electrically conductive polymers.

10. The flexible MEMS transducer as claimed in claim 9, wherein the metal is aluminum.

11. The flexible MEMS transducer as claimed in claim 1, wherein the lower electrode layer has a thickness of between about 0.01 μm to 5 μm .

12. The flexible MEMS transducer as claimed in claim 1, wherein the upper electrode layer has a thickness of between about 0.01 μm to 5 μm .

13. The flexible MEMS transducer as claimed in claim 1, wherein the piezopolymer is selected from the group consisting of PVDF, PVDF-TrEF, TrEF, Polyurea, polyimide and Nylon.

14. The flexible MEMS transducer as claimed in claim 1, wherein the active layer has a thickness of between about 1 μm to 10 μm .

15. The flexible MEMS transducer as claimed in claim 1, wherein the active layer has a resonance frequency of between about 1 Hz to 100 kHz.

16. The flexible MEMS transducer as claimed in claim 1, wherein the active layer has a length of between about 50 μm to 1000 μm .

17. The flexible MEMS transducer as claimed in claim 1, further comprising an upper protective layer to cover the upper and lower electrode layers and the active layer.

18. The flexible MEMS transducer as claimed in claim 17, wherein the upper protective layer is formed of either silicon nitride or silicon oxide.

19. The flexible MEMS transducer as claimed in claim 1, wherein the upper protective layer has a thickness of between about 1 μm to 10 μm .

20. The method as claimed in claim 1, wherein the first connecting pad and the second connecting pad are formed of a material selected from the group consisting of metals and electrically conductive polymers.

21. A method for manufacturing a flexible MEMS transducer comprising:

forming a sacrificial layer on a flexible substrate;

depositing a membrane layer on the sacrificial layer by plasma enhanced chemical vapor deposition (PECVD), followed by patterning;

depositing a lower electrode layer on the membrane layer, and patterning the lower electrode layer;

sequentially depositing an active layer and an upper electrode layer on the lower electrode layer and sequentially patterning the upper electrode layer and the active layer;

forming a first connecting pad to be connected to the lower electrode layer and a second connecting pad to be connected to the upper electrode layer; and

removing the sacrificial layer.

22. The method as claimed in claim 21, further comprising:

forming a lower protective layer by depositing either silicon nitride or silicon oxide by PECVD, before depositing the sacrificial layer.

23. The method as claimed in claim 21, wherein forming the sacrificial layer is performed by coating a polyimide layer on the substrate and patterning the coated polyimide layer by either wet etching or dry etching in accordance with a desired configuration of the membrane layer.

24. The method as claimed in claim 21, wherein the sacrificial layer is formed to a thickness of less than about 10 μm .

25. The method as claimed in claim 21, wherein forming the membrane layer comprises:

depositing a silicon nitride layer on the sacrificial layer by plasma enhanced chemical vapor deposition (PECVD); and
patterning the deposited silicon nitride layer by dry etching.

26. The method as claimed in claim 21, wherein forming the active layer comprises:

depositing a piezopolymer layer on the lower electrode layer by either spin coating or evaporation; and

patterning the deposited piezopolymer layer by either wet etching or dry etching.

27. The method as claimed in claim 26, wherein the piezopolymer is selected from the group consisting of PVDF, PVDF-TrEF, TrEF, Polyurea, polyimide and Nylon.

28. The method as claimed in claim 21, wherein the active layer is formed to a thickness less than about 10 μm .

29. The method as claimed in claim 21, further comprising:
forming an upper protective layer to cover the upper and lower electrode layers and the active layer, in which the upper protective layer is

formed by depositing either silicon nitride or silicon oxide by PECVD and then patterning the deposited layer by either wet etching or dry etching.

30. The method as claimed in claim 29, wherein the upper protective layer is formed to a thickness of less than about 10 μm .

31. The method as claimed in claim 21, wherein forming the first connecting pad comprises:

patterning the upper protective layer at a portion to be connected to the lower electrode layer by either wet etching or dry etching;

depositing a metal layer or an electrically conductive polymer layer thereon; and

patterning the deposited layer by either wet etching or dry etching.

32. The method as claimed in claim 21, wherein forming the second connecting pad comprises:

patterning the upper protective layer at a portion to be connected to the upper electrode layer by either wet etching or dry etching;

depositing a metal layer or an electrically conductive polymer layer thereon; and

patterning the deposited layer by either wet etching or dry etching.

33. A flexible wireless MEMS microphone, comprising:

- a substrate of a flexible polymeric material;
- a flexible MEMS transducer structure formed on the substrate by plasma enhanced chemical vapor deposition (PECVD);
- an antenna printed on the substrate for communicating with an outside source;
- a wire and interface circuit embedded in the substrate to electrically connect the flexible MEMS transducer and the antenna;
- a flexible battery layer electrically connected to the substrate for supplying power to the MEMS transducer; and
- a flexible bluetooth module layer electrically connected to the battery layer.

34. The flexible wireless MEMS microphone as claimed in claim 33, wherein the substrate is formed of a high-molecular (polymeric) material.

35. The flexible wireless MEMS microphone as claimed in claim 34, wherein the high-molecular (polymeric) material is polyimide.

36. The flexible wireless MEMS microphone as claimed in claim 33, wherein the battery layer is a polymer battery having a paper-like thinness.

37. The flexible wireless MEMS microphone as claimed in claim 33, wherein the battery layer is a flexible solar cell.

38. The flexible wireless MEMS microphone as claimed in claim 33, wherein the flexible MEMS transducer comprises:

a membrane layer, a lower electrode layer, a piezopolymeric active layer, an upper electrode layer and a first and a second connecting pad connected to the lower electrode layer and the upper electrode layer, respectively, which are sequentially deposited by plasma enhanced chemical vapor deposition (PECVD) and patterned on the substrate having a sacrificial layer formed thereon.

39. The flexible wireless MEMS microphone as claimed in claim 33, wherein the flexible substrate, on which the flexible MEMS transducer is formed, the antenna is printed, and the wire and interface circuit are embedded, is able to be folded at a predetermined angle.

40. The flexible wireless MEMS microphone as claimed in claim 39, wherein the predetermined angle is in the range of less than about 180°.

41. A flexible MEMS wireless microphone comprising
a flexible substrate, which has a flexible MEMS transducer structure
formed by plasma enhanced chemical vapor deposition (PECVD), an
antenna printed thereon to be electrically connected to the MEMS
transducer structure and for communicating with an outside source and a
wire and interface circuit embedded therein for electrically connecting the
flexible MEMS transducer and antenna;
a flexible battery layer electrically connected to the flexible substrate;
and
a bluetooth module layer, which are sequentially deposited to a
predetermined thickness.

42. The flexible wireless MEMS microphone as claimed in claim 41,
wherein the flexible MEMS wireless microphone is able to be folded at a
predetermined angle.

43. The flexible wireless MEMS microphone as claimed in claim 41,
wherein the predetermined angle is in the range of less than about 180°.

44. The flexible wireless MEMS microphone as claimed in claim 41,
wherein the flexible wireless MEMS microphone is formed into a desired
three-dimensional structure by cutting in accordance with a side shape of the

desired three-dimensional structure and folding the cut piece at a predetermined angle, followed by assembling into the three-dimensional structure.

45. A method for manufacturing a flexible MEMS transducer, comprising:

forming a sacrificial layer on a flexible substrate;

sequentially depositing on the sacrificial layer by a plasma enhanced chemical vapor deposition (PECVD) process, a membrane layer, a lower electrode layer, an active layer and an upper electrode layer;

sequentially patterning the upper electrode layer, the active layer and the lower electrode layer;

depositing an upper protective layer to cover the upper electrode layer, the lower electrode layer and the active layer;

patterning the upper protective layer for a connection of the lower electrode layer and of the upper electrode layer, depositing a connecting pad layer, and patterning the connecting pad layer to form a first connecting pad to be connected with the lower electrode layer and a second connecting pad to be connected with a connection part of the upper electrode layer; and

patterning the membrane layer to expose the sacrificial layer and removing the sacrificial layer.

46. The method as claimed in claim 45, further comprising:
forming a lower protective layer by depositing one of a material selected from the group consisting of silicon nitride and silicon oxide on the flexible substrate by a method selected from PECVD and sputtering, prior to the deposition of the sacrificial layer.
47. The method as claimed in claim 45, wherein the sacrificial layer has a thickness of less than about 10 μm .
48. The method as claimed in claim 45, wherein the membrane layer is formed by depositing a silicon nitride.
49. The method as claimed in claim 45, wherein the active layer is formed by depositing a piezopolymer layer on the lower electrode layer by either spin coating or evaporation.
50. The method as claimed in claim 49, wherein the piezopolymer is selected from the group consisting of PVDF, PVDF-TrEF, TrEF, Polyurea, polyimide and Nylon.
51. The method as claimed in claim 45, wherein the active layer is formed to a thickness of less than about 10 μm .

52. The method as claimed in claim 45, wherein the upper protective layer is formed to a thickness of less than about 10 μm .